ABUNDANCE AND SIZE-CLASS STRUCTURE OF DUNGENESS CRABS IN OR NEAR FREQUENTLY-DREDGED AREAS IN THE COLUMBIA RIVER ESTUARY

by
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INTRODUCTION

In October 1985, the National Marine Fisheries Service (NMFS) completed a 2-year study of Dungeness crabs, Cancer magister, in the Columbia River estuary (McCabe et al. 1986). The main objectives of the study, which was funded primarily by the Portland District, U.S. Army Corps of Engineers (COE), were to determine estuarine distribution, relative abundance, size-class structure, and location and timing of movements across the bar (River Mile 0.7 to 2.8 [1/]) of Dungeness crabs. The 2-year study demonstrated that crab densities can fluctuate annually in the estuary. For example, densities on the bar in the spring and summer of 1984 were less than 115 crabs/hectare (ha) whereas during the same period in 1985, densities exceeded 1,800 crabs/ha.

Because of the apparently large annual fluctuations in crab densities at some frequently-dredged estuarine areas, the COE requested that NMFS continue to sample at some of the established sampling stations. The objectives of the extended study are to describe the abundance and size-class structure of Dungeness crabs in or near frequently-dredged areas in the Columbia River estuary. The observations will expand the overall data base on Dungeness crabs in the estuary, specifically in areas subjected to frequent dredging, and will also provide additional information for COE crab entrainment studies. Results for the first year of the extended study are reported in McCabe et al. (1987). This report describes research done from January through September 1987.

1/ River Mile is used in this report because of its common usage in navigation charts.

METHODS AND MATERIALS

Samples were collected at established sites (McCabe et al. 1986) in the Columbia River estuary from January through September 1987. Stations 3 (Ilwaco Channel), 6 (Chinook Channel), and 10 (Flavel Bar area) were sampled monthly (Fig. 1); the six bar stations (Stations 1, 2, 23, 24, 25, and 26) were sampled biweekly from April through September 1987. The bar stations were not sampled during winter.

Samples were collected with an 8-m semiballoon shrimp trawl towed for 5 minutes at each estuarine site during the flood tide. Overall mesh size in the trawl was 38.1 mm (stretched), with a 12.7-mm mesh liner placed in the cod end of the net to prevent the escape of young-of-the-year crabs. The distance traveled during a sampling effort was generally estimated using either a radar range-finder or Loran-C navigational equipment. By using the distance traveled and the fishing width of the trawl, which was estimated to be about 5 m by the manufacturer, we were able to calculate crab densities. Densities are reported as numbers of crabs/ha.

Before each sampling effort, salinity (ppt) and temperature(^{0}C) were measured at the surface and near the bottom using a Beckman RS5-3[2/] salinometer and temperature probe.

Usually a subsample of up to 100 crabs from each sampling effort was measured (mm), weighed (g), and checked for eggs. Crabs were measured across the carapace, anterior to the tenth anterolateral spines. If the catch exceeded 100, the excess was counted. For data analysis, crabs were separated into four size-classes: I (<50 mm), II (50-99 mm), III (100-129 mm), and IV (>129 mm).

2/ Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

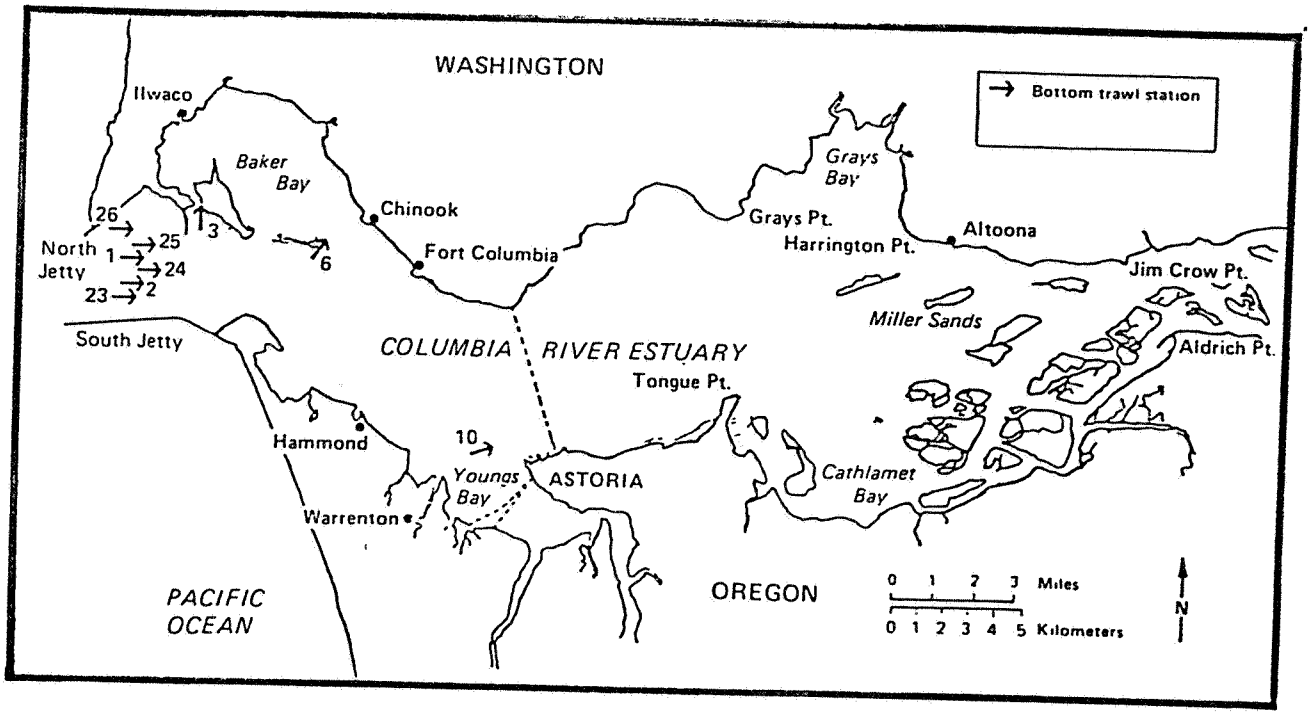

Figure 1.--Map of the Columbia River estuary, showing the Dungeness crab sampling stations.

RESULTS AND DISCUSSION

At the six bar stations, crab densities varied spatially and temporally, with the highest biweekly densities generally occurring at one of the northernmost stations, Station 25 or 26 (Table 1). Mean biweekly crab density (all bar stations combined) was highest on 11 May (108 crabs/ha) and lowest on 22 July (10 crabs/ha). All mean biweekly densities were less than 80 crabs/ha, with the exception of the density on 11 May.

In 1987, mean monthly densities on the bar were generally similar or lower than densities in the same months in 1984-86 (Table 2; McCabe et al. 1986, 1987). Excluding June and July 1985, mean monthly densities in the April-September period in all 4 years did not exceed 220 crabs/ha.

In 1987, densities of young-of-the-year (Y-O-Y) Dungeness crabs on the bar were low (Table 2). The Y-O-Y Dungeness crabs were collected from 27 April through 21 September (Appendix Figs. A1, A2). On 13 April, one Dungeness crab megalops larva was collected on the bar, and on 27 April, the catch increased to 164 megalops larvae and 20 Y-O-Y crabs. The mean density of Y-O-Y crabs increased in May, but declined in June and dropped to densities of less than 5 Y-O-Y/ha in July-September. The Y-O-Y Dungeness crabs were captured earlier in the year in 1987 in comparison to 1984, 1985, and 1986 (Table 2). In April and May 1987, Y-O-Y densities were higher than in those months in any of the three previous years. Based on May's sampling, it appeared that 1987 would be similar to 1985 when large numbers of Y-O-Y were captured on the bar in June and July; however, catches declined in June and July 1987. Except for June-August 1985, mean monthly Y-O-Y densities on the bar during all 4 years were less than 100/ha.

On a monthly basis, similar sized Dungeness crabs were captured at the bar stations from April through September 1987, although the proportional

Table 1.--Dungeness crab densities (number/hectare) at the six bar stations in the Columbia River estuary; crabs were collected with an 8-m shrimp trawl during April-September 1987. Crabs were separated into four size-classes: I (<50 mm), II (50-99 mm), III (100-129 mm), and IV (>129 mm).

Date	Size Class	Station 1	2	23	24	25	26
13 Apr	I	0	0	0	0	0	0
	II	0	0	0	0	0	0
	III	3	0	0	9	65	26
	IV	0	3	0	13	29	2
	Total	3	3	0	22	94	28
27 Apr	I	13	3	0	0	33	20
	II	0	0	0	0	0	0
	III	3	0	4	15	46	14
	IV	8	0	7	0	29	11
	Total	24	3	11	15	108	45
11 May	I	34	31	44	11	6	231
	II	0	0	0	0	0	5
	III	6	3	0	10	8	113
	IV	9	0	4	0	3	128
	Total	49	34	48	21	17	477
26 May	I	92	36	8	24	67	63
	II	0	0	0	0	0	0
	III	3	0	0	2	0	26
	IV	11	3	0	8	16	90
	Total	106	39	8	34	83	179

Table 1.--cont.

Date	Size Class	Station 1	2	23	24	25	26
9 Jun	I	46	8	6	50	25	34
	II	0	0	0	0	0	0
	III	16	0	0	2	20	3
	IV	36	4	5	8	17	17
	Total	98	12	11	60	62	54
23 Jun	I	10	3	0	28	7	13
	II	0	0	0	0	0	0
	III	0	0	0	2	3	8
	IV	3	0	5	4	2	25
	Total	13	3	5	34	12	46
8 Jul	I	7	3	0	8	0	4
	II	0	0	0	0	0	0
	III	10	0	4	0	3	13
	IV	7	0	17	4	10	33
	Total	24	3	21	12	13	50
22 Jul	I	9	0	0	0	0	-[a/]
	II	0	0	0	0	0	-
	III	0	0	0	0	5	-
	IV	0	2	3	30	0	-
	Total	9	2	3	30	5	-
6 Aug	I	0	0	4	5	0	-
	II	0	0	0	0	0	-
	III	0	3	13	11	0	-
	IV	19	29	22	24	0	-
	Total	19	32	39	40	0	-

Table 1.--cont.

Date	Size Class	Station 1	2	23	24	25	26
20 Aug	I	7	0	0	0	0	-
	II	0	0	0	0	0	-
	III	4	2	7	0	0	-
	IV	17	5	11	9	13	-
	Total	28	7	18	9	13	-
8 Sep	I	0	0	0	0	0	-
	II	0	0	0	0	0	-
	III	3	0	7	0	14	-
	IV	10	5	4	13	80	-
	Total	13	5	11	13	94	-
21 Sep	I	0	0	-	0	0	18
	II	0	0	-	0	0	0
	III	3	5	-	0	7	0
	IV	26	11	-	7	15	29
	Total	29	16	-	7	22	47

a/ Indicates that the station was not sampled. Station 26 was not sampled at times because of crab pots in the area, and Station 23 was not sampled on 21 September because of unfavorable bar conditions.

Table 2.--Average densities (number/hectare) of Dungeness crabs (all size classes combined) on the Columbia River bar from April through September, 1984-87; average densities of young-of-the-year are shown in parentheses. Each number is the average of catches from 6 to 12 trawling efforts.

Month	Year			
	1984	1985	1986	1987
Apr	20 (0)	41 (0)	34 (0)	30 (6)
May	44 (13)	53 (11)	31 (0)	91 (54)
Jun	110 (96)	1,884 (1,876)	85 (14)	34 (19)
Jul	38 (34)	2,262 (2,251)	28 (2)	16 (3)
Aug	28 (6)	178 (153)	104 (1)	20 (2)
Sep	66 (48)	76 (35)	218 (0)	26 (2)

importance of the size classes changed (Table 1; Appendix Figs. A1, A2). Size Class I (<50 mm carapace width) crabs (primarly Y-O-Y) were present in all months, along with Size Classes III (100-129 mm) and IV (>129 mm); Size Class II (50-99 mm) crabs were virtually absent from the bar catches.

Crab densities at the three stations upstream from the bar fluctuated spatially and temporally (Table 3). Generally, densities in Ilwaco and Chinook Channels (Stations 3 and 6) were greater than 140 crabs/ha whereas densities in the Flavel Bar area (Station 10) were less than 70 crabs/ha. At Station 3, densities were highest in May (3,386 crabs/ha) and lowest in September (87 crabs/ha). Densities at Station 6 were highest in January, August, and September (about 1,000 crabs/ha) and lowest in February and April (168 and 147 crabs/ha, respectively). At Station 10, densities were highest in August (354 crabs/ha) and lowest in January, April, and June (about 30 crabs/ha).

Densities at the three stations upstream from the bar were compared to densities in preceding years (Tables 4-6; McCabe et al. 1986, 1987). At Station 3, densities in February, April, and May 1987 were much higher than densities in the same months in preceding years whereas the density in September was markedly lower than densities in preceding years (Table 4). Densities at Station 6 in 1987 followed a general pattern similar to 1984 and 1985, with lowest densities in the February-May period (Table 5). The unusually low densities in January-April 1985 were in part due to hopper dredging in the area during the fall 1984. At Station 10, monthly crab densities in 1987 did not follow a pattern similar to the two preceding years (Table 6). In 1985 and 1986, crab densities in the March-June period tended to be relatively high, with a large decline in July or August. In 1987, crab densities were consistently low in the March-July period and increased dramatically in August, with a subsequent decline in September.

Table 3.--Dungeness crab densities (number/hectare) at three stations in the Columbia River estuary; crabs were collected with an 8-m shrimp trawl during January-September 1987. Crabs were separated into four size classes: I (<50 mm), II (50-99 mm), III (100-129 mm), and IV (>129 mm).

Date	Size Class	Station 3	Station 6	Station 10
13 Jan	I	0	0	0
	II	146	541	0
	III	49	439	27
	IV	0	61	5
	Total	195	1,041	32
10 Feb	I	6	0	0
	II	156	60	36
	III	60	103	206
	IV	6	5	5
	Total	228	168	247
12 Mar	I	15	0	0
	II	230	165	7
	III	58	85	58
	IV	14	28	0
	Total	317	278	65
10 Apr	I	0	0	0
	II	449	85	5
	III	40	31	9
	IV	0	31	14
	Total	489	147	28

Table 3.--cont.

Date	Size Class	Station 3	Station 6	Station 10
12 May	I	0	30	0
	II	2,471	126	5
	III	881	132	34
	IV	34	24	10
	Total	3,386	312	49
8 Jun	I	13	0	0
	II	588	135	10
	III	676	378	14
	IV	95	149	10
	Total	1,372	662	34
7 Jul	I	6	0	0
	II	238	101	21
	III	358	264	21
	IV	68	236	15
	Total	670	601	57
4 Aug	I	6	0	0
	II	42	451	162
	III	150	393	133
	IV	48	254	59
	Total	246	1,098	354
3 Sep	I	0	10	0
	II	36	494	4
	III	31	345	23
	IV	20	226	27
	Total	87	1,075	54

Table 4.--Densities (number/hectare) of Dungeness crabs (all size classes combined) in Ilwaco Channel (Station 3), Columbia River estuary, from January through September, 1984-87. Each number represents one trawling effort. No sampling was done in February 1986.

Month	Year			
	1984	1985	1986	1987
Jan	159	81	205	195
Feb	72	51	-	228
Mar	185	330	1,432	317
Apr	22	22	97	489
May	65	23	6	3,386
Jun	36	2,222	317	1,372
Jul	86	240	438	670
Aug	683	438	38	246
Sep	514	727	317	87

Table 5.--Densities (number/hectare) of Dungeness crabs (all size classes combined) in Chinook Channel (Station 6), Columbia River estuary, from January through September, 1984-87. Each number represents one trawling effort. No sampling was done in February 1986.

Month	Year			
	1984	1985	1986	1987
Jan	744	0	257	1,041
Feb	227	0	-	168
Mar	147	24	736	278
Apr	60	34	463	147
May	122	137	966	312
Jun	372	533	1,295	662
Jul	986	896	2,015	601
Aug	741	10,799	494	1,098
Sep	730	16,116	356	1,075

Table 6.--Densities (number/hectare) of Dungeness crabs (all size classes combined) in the Flavel Bar area (Station 10), Columbia River estuary, from January through September, 1985-87. Each number represents one trawling effort. No sampling was done in February 1986.

Month	Year		
	1985	1986	1987
Jan	211	41	32
Feb	192	-	247
Mar	590	180	65
Apr	205	786	28
May	428	254	49
Jun	460	1,244	34
Jul	491	92	57
Aug	5	47	354
Sep	17	92	54

Overall, at Stations 3, 6, and 10, Size Classes II (50-99 mm carapace width) and III (100-129 mm) were the dominant size classes. Generally, densities of Size Class I (<50 mm) crabs were zero or very low (Table 3; Appendix Figs. A3-A11). The Y-O-Y crabs were virtually absent at the three stations.

Actual crab densities in the Columbia River estuary were probably higher than indicated by our trawl catches. The sampling efficiency of our 8-m semiballoon shrimp trawl for different size classes of Dungeness crabs in the Columbia River estuary is unknown. In Humboldt Bay, California, Gotshall (1978) estimated that his 4.9-m bottom trawl was about 50% efficient in collecting Dungeness crabs. Stevens and Armstrong (1984), who estimated crab populations in Grays Harbor estuary, Washington, used a sampling efficiency of 3.3% for early instar crabs collected with a 4.9-m semiballoon otter trawl.

Crab research in 1986 and 1987 (the present study) is a continuation of the 1983-85 crab research (McCabe et al. 1986) at fewer sites in the estuary. Data collected in 1986 (McCabe et al. 1987) and 1987 substantiate spatial and temporal fluctuations in crab densities observed in the estuary during the earlier crab study. As more data are collected, confidence in predicting seasonal density patterns at various estuarine sites should improve. Use of this information has and will continue to aid resource managers in making decisions about dredging in the estuary.

ACKNOWLEDGMENTS

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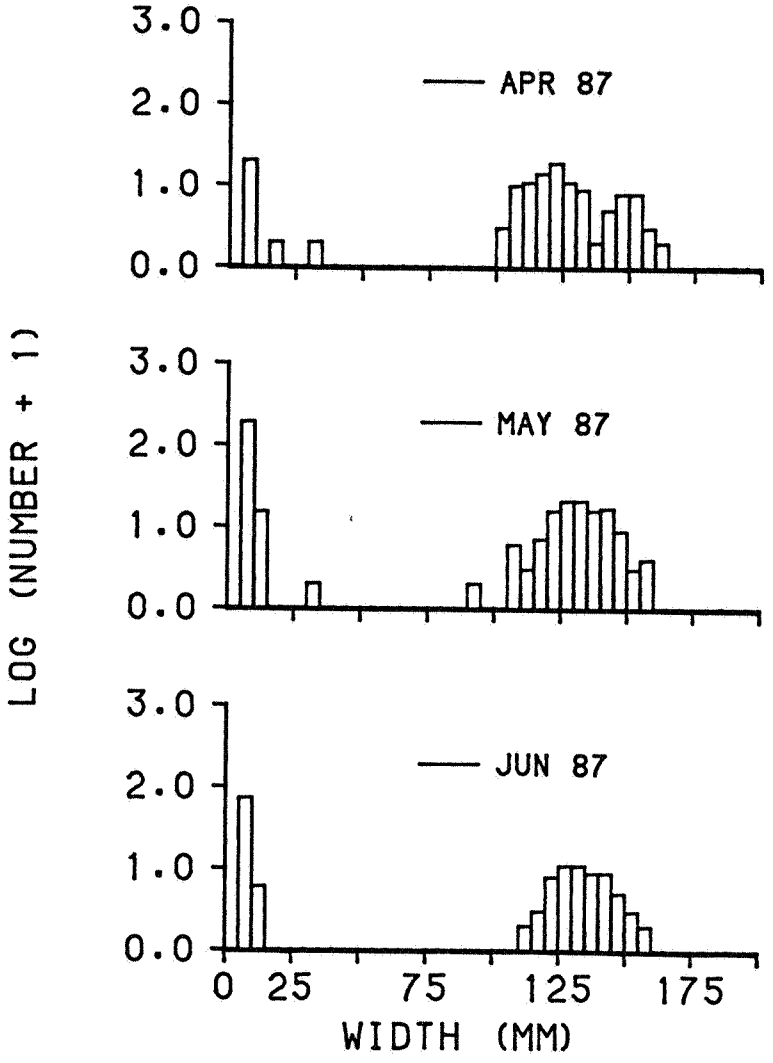
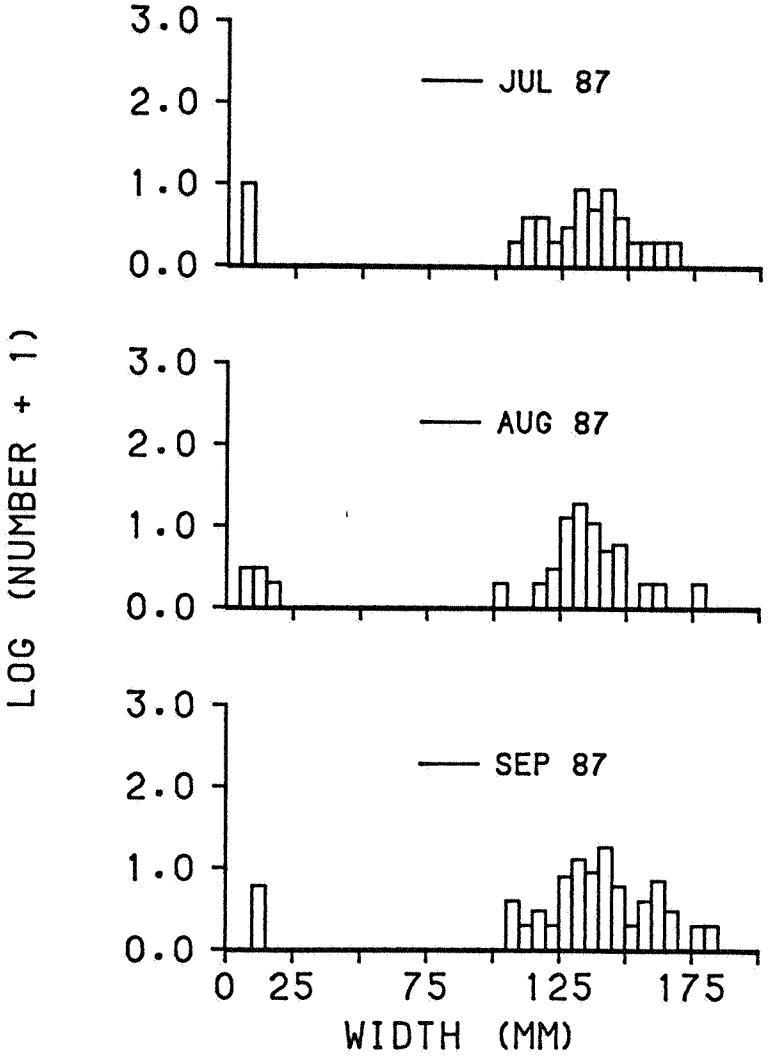
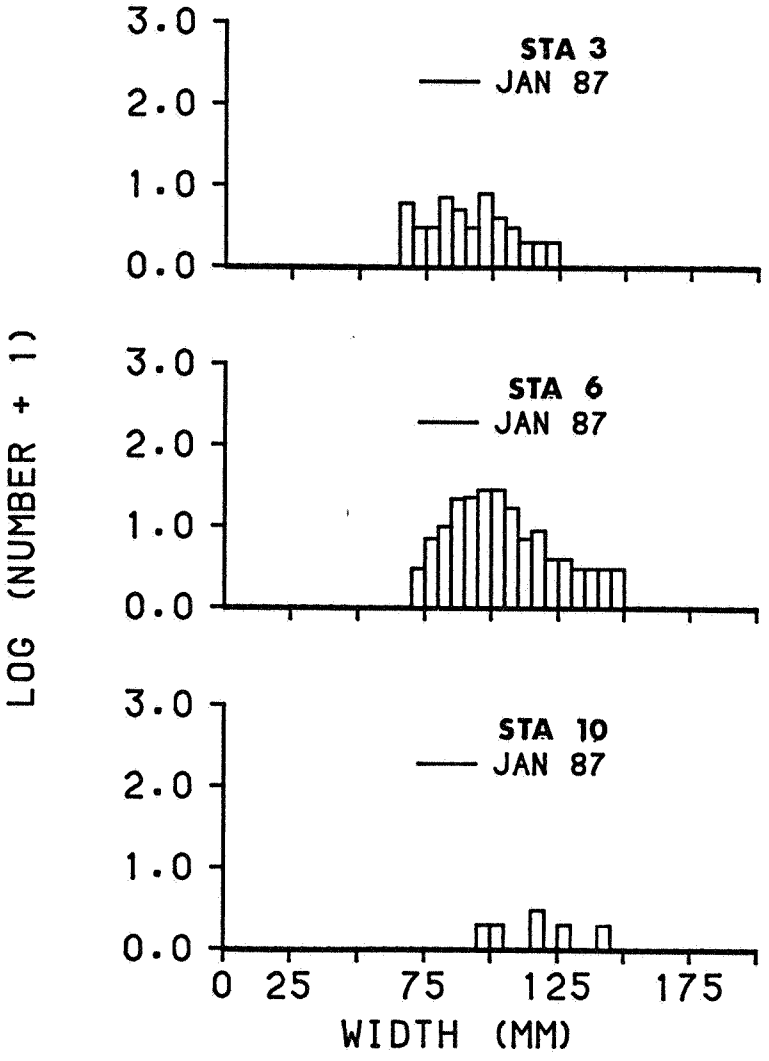
APPENDIX A.--Width-frequency histograms for Dungeness crabs collected in the Columbia River estuary from January through September 1987.



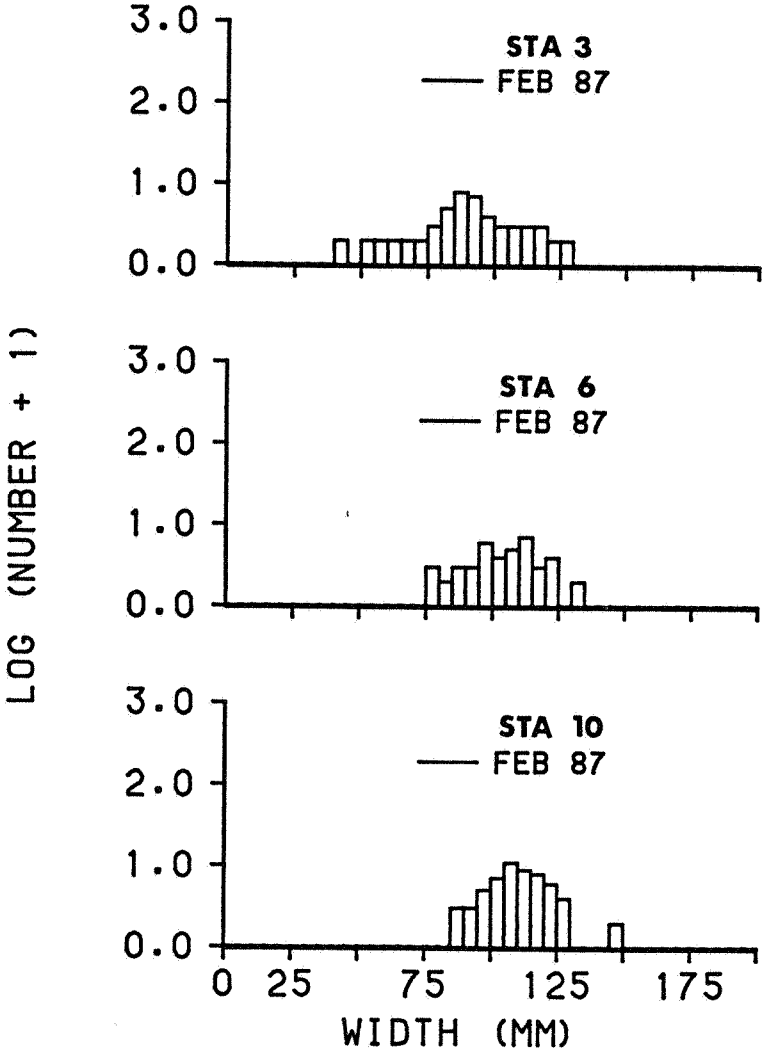
Appendix Figure A1.--Width-frequency histograms for Dungeness crabs collected on the Columbia River bar from April through June 1987. Each histogram includes data collected from 12 trawling efforts.



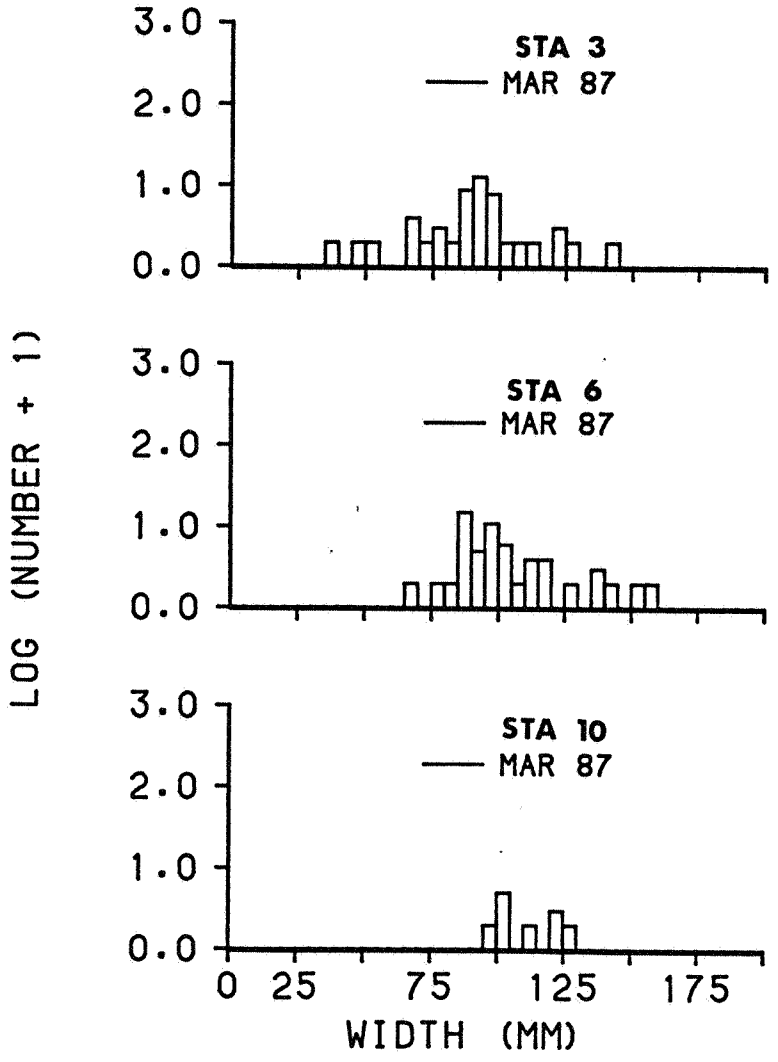
Appendix Figure A2.--Width-frequency histograms for Dungeness crabs collected on the Columbia River bar from July through September 1987. Each histogram includes data collected from 10-11 trawling efforts.



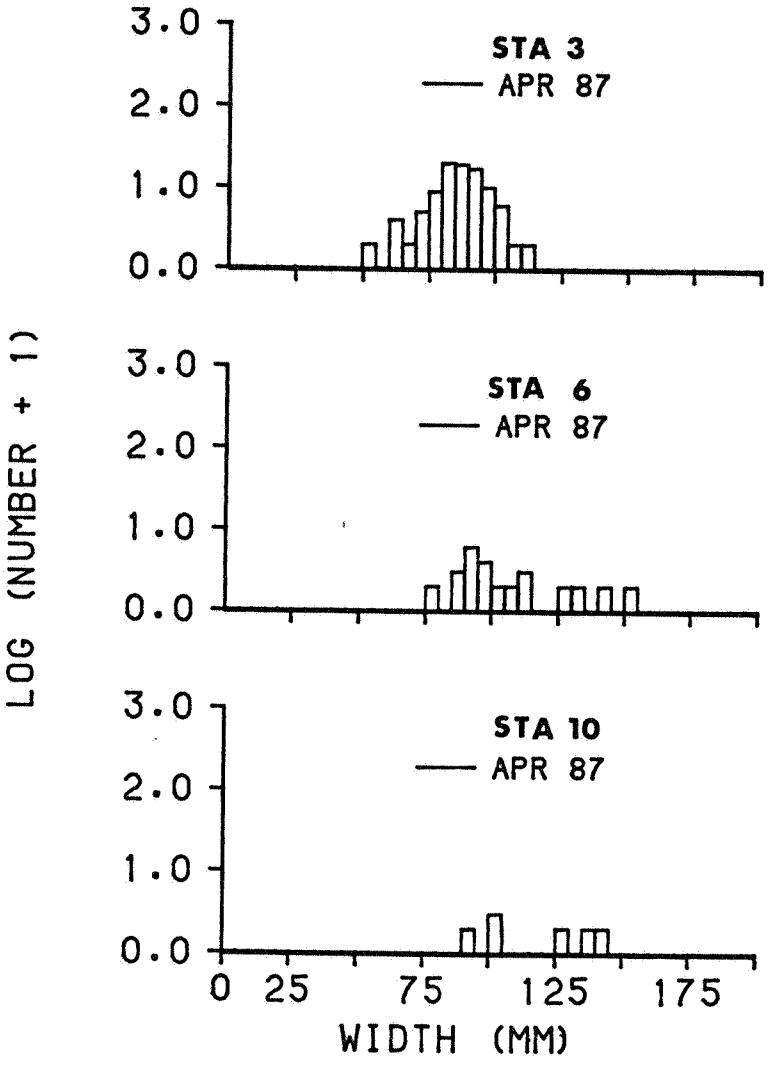
Appendix Figure A3.--Width-frequency histograms for Dungeness crabs collected at Stations 3, 6, and 10, Columbia River estuary, January 1987. One trawling effort was done at each station.



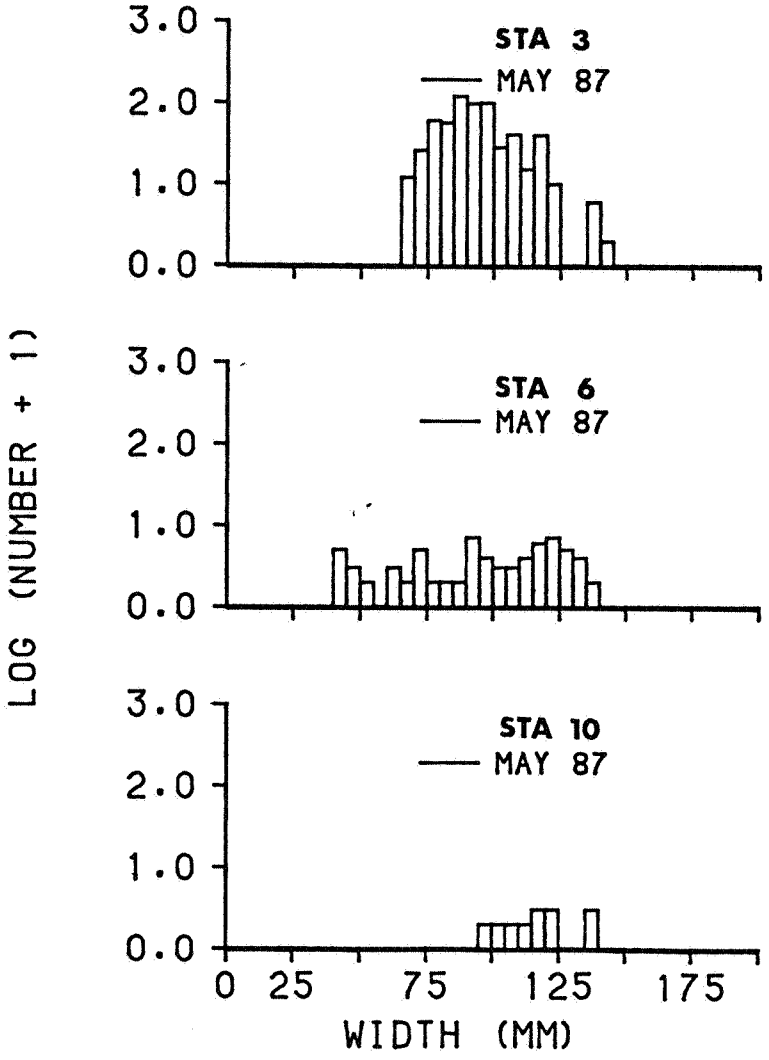
Appendix Figure A4.--Width-frequency histograms for Dungeness crabs collected at Stations 3, 6, and 10, Columbia River estuary, February 1987. One trawling effort was done at each station.



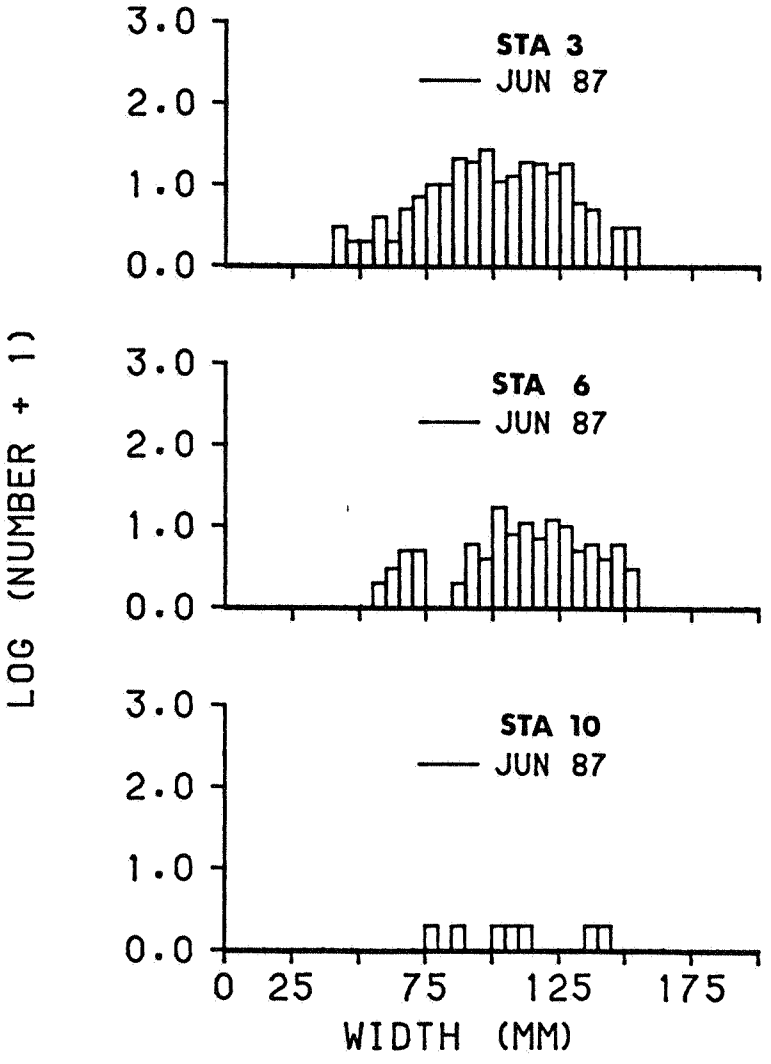
Appendix Figure A5.--Width-frequency histograms for Dungeness crabs collected at Stations 3, 6, and 10, Columbia River estuary, March 1987. One trawling effort was done at each station.



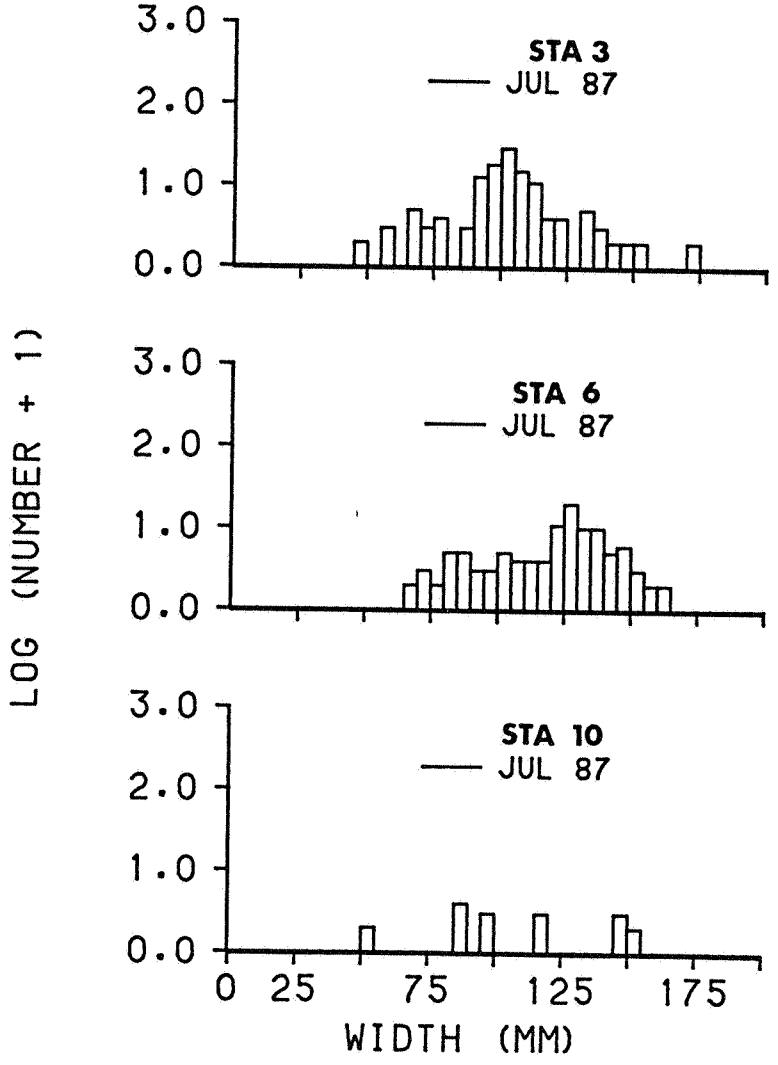
Appendix Figure A6.--Width-frequency histograms for Dungeness crabs collected at Stations 3, 6, and 10, Columbia River estuary, April 1987. One trawling effort was done at each station.



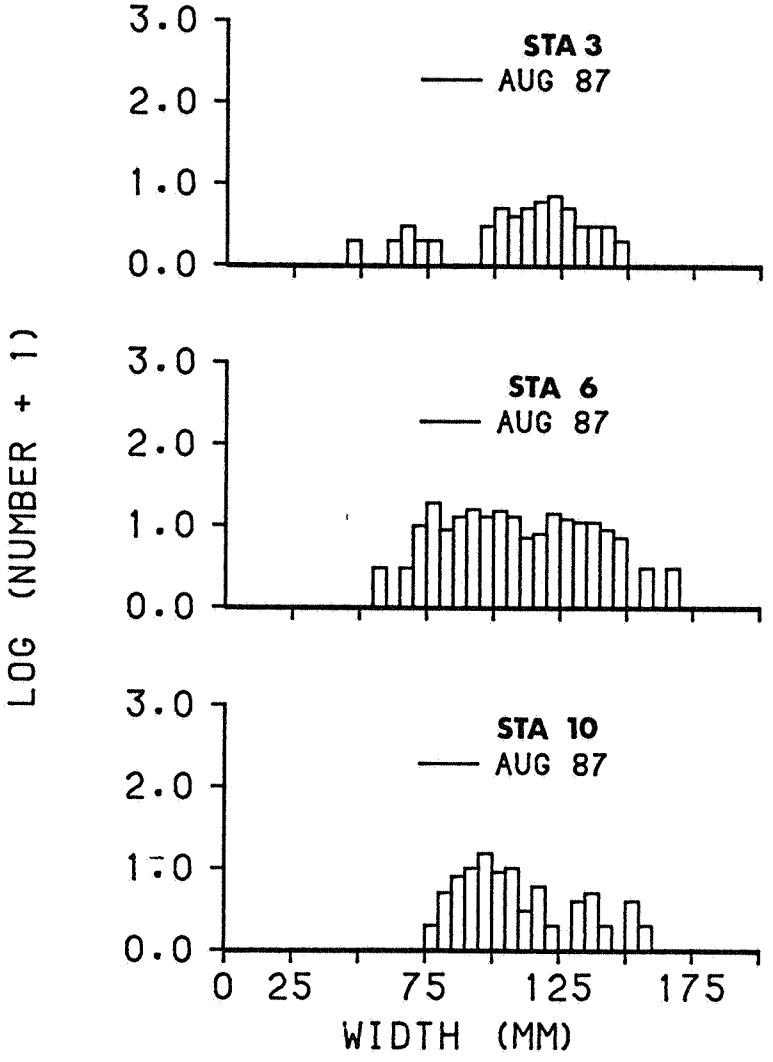
Appendix Figure A7.--Width-frequency histograms for Dungeness crabs collected at Stations 3, 6, and 10, Columbia River estuary, May 1987. One trawling effort was done at each station.



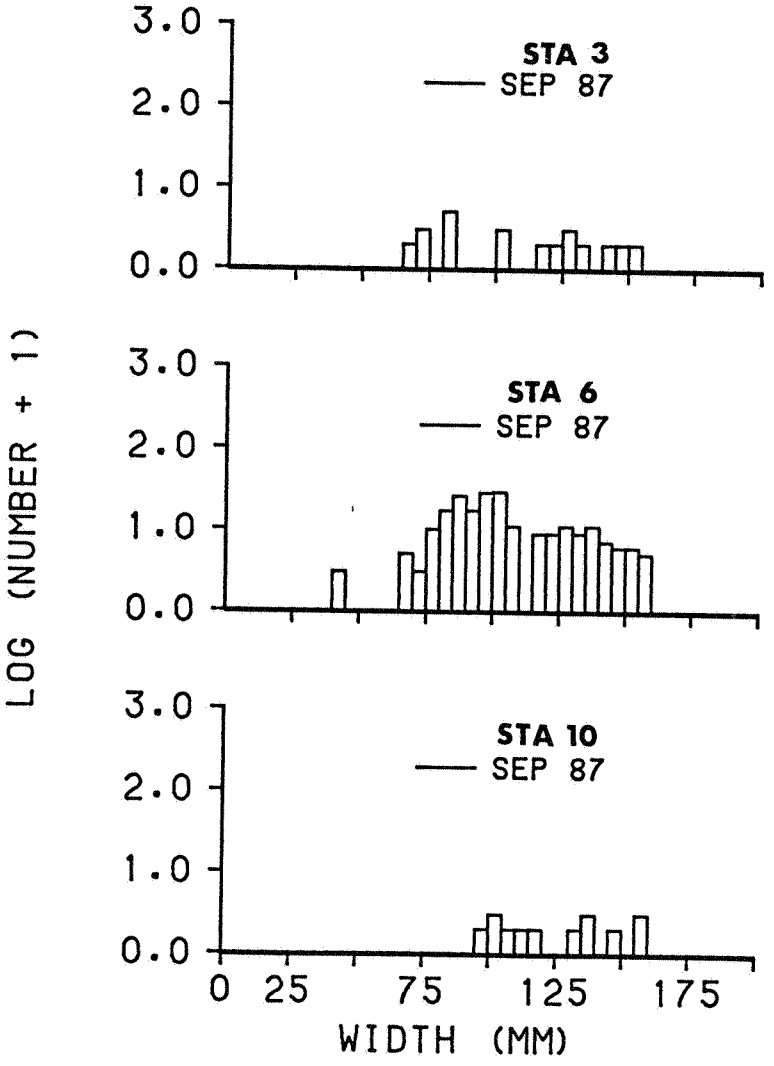
Appendix Figure A8.--Width-frequency histograms for Dungeness crabs collected at Stations 3, 6, and 10, Columbia River estuary, June 1987. One trawling effort was done at each station.



Appendix Figure A9.--Width-frequency histograms for Dungeness crabs collected at Stations 3, 6, and 10, Columbia River estuary, July 1987. One trawling effort was done at each station.



Appendix Figure A10.--Width-frequency histograms for Dungeness crabs collected at Stations 3, 6, and 10, Columbia River estuary, August 1987. One trawling effort was done at each station.



Appendix Figure A11.--Width-frequency histograms for Dungeness crabs collected at Stations 3, 6, and 10, Columbia River estuary, September 1987. One trawling effort was done at each station.